

Eco Char	Vital Sign Category	Monitoring Objectives	VS Id#	Vital Sign	Monitoring Question(s)	Monitoring Method	Metrics	Vital Sign Rank (0-5)	Comments / Notes
Biotic Integrity	Terrestrial Ecosystems	Vegetation	Population	Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species	T13 Native Plant Species Protection (T, E, S-o-C species)	What are the distribution, abundance, and demographics of threatened, endangered, and rare native plant species? Are plant populations reproducing at self-sustaining levels?	Mapping, plots, counts in size classes	phenology, survival, soil seed bank, population structure, Distribution, density, reproduction	4.0
				Monitor community dynamics, structure, function, and composition	T19 Terrestrial Vertebrate (including off-shore islets refugia) Biodiversity	Are there long-term changes in selected native vertebrate communities?	Population surveys	Abundance and trends of selected vertebrate species or groups	3.3
				Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species	T23 Forest Birds and Bats (includes T & E spp.)	Are distribution, abundance, other population characteristics, or habitat changing? Determine population levels over time.	Population surveys (forest bird methods differ from those for raptors or bats)	Abundance / density, distribution	3.1
				Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species	T25 Invertebrate Charismatic or Species of Concern	Are distribution, abundance, other population characteristics, or habitat changing? Determine population levels over time.	Population surveys	Abundance / density, demographics, distribution	3.2
				Monitor disease incidence and impacts, especially on native species	T26 Seabirds (including T & E spp.)	Are distribution, abundance, other population characteristics, or habitat changing? Determine population levels over time.	Population surveys	Abundance / density, distribution	3.5
		Consumers	Population	Monitor disease incidence and impacts, especially on native species	T27 Shorebirds and Waterbirds (including T & E spp.)	Are distribution, abundance, other population characteristics, or habitat changing? Determine population levels over time.	Population surveys	Abundance / density, distribution	3.3
				Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species	T29 Terrestrial Invertebrate Species Protection (T, E, S-o-C Species)	Are distribution, abundance, other population characteristics, or habitat changing?	Mapping, plots, population surveys	abundance, distribution, demographics	2.9
	Marine Ecosystems	Water column (molt)	Population	Monitor disease incidence and impacts, especially on native species	T30 Established Disease & Pathogens of Terrestrial Vertebrates	What is the incidence and level of disease in populations? Are diseases/pathogens affecting populations? What are trends in disease/pathogen?	Continue to monitor bird, bat, and herp populations (VCP, mist-netting)	incidence, Presence/ absence	2.5
				Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species	T31 Alien Incipient Disease & Pathogens of Terrestrial Vertebrates	Where are disease locations outside parks? What species are they affecting? What are rates and directions of spread? Identify existing disease/pathogen incidence, impact, and trends	Surveys in high risk sites; passive surveillance, education, outreach, public reporting, and follow-up	Presence/absence, rapid assessment of extent of infestations (distribution, identification and numbers of host and/or vector species involved)	2.5
				Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species	M20 Marine Species Protection (T, E, S-o-C species)	Is variation within normal range? What are temporal trends?	telemetry, quadrats, transects, aerial surveys	abundance, demographics, distribution, movement	3.3

Intro, Monitoring goals & objectives, Conceptual Models, and Vital Signs

Also use main handout of review materials (http://www.nature.nps.gov/im/units/pacn/monitoring/plan/vs04/review_materials.htm)

Ecological Characteristic	Vital Sign Category		Monitoring Objectives
Human activities & cultural practices	Soundscapes		Monitor sound sources, frequencies, occurrence, and levels
	Viewscapes / Lightscapes		Monitor landscape / seascape appearance Monitor light levels and characteristics of light/dark cycles
	Land Use		Monitor points of entry for invasive species Monitor water use adjacent to or upstream from park boundaries Monitor land use adjacent to, or upstream of, park boundaries
	Park Use & Activities		Monitor debris-trash occurrence in coastal, riparian, wetland, and lacustrine habitats; in or near high use areas Monitor patterns of park visitation, use & damage (terrestrial & marine) Monitor incidence & occurrence of bioprospecting
	Management Zones		Monitor levels of take & harvest of harvested species (marine, freshwater, and terrestrial) or resources (coral, sand) Monitor patterns and effects of use and management Monitor effects of management practices on wilderness character
			Monitor visibility Track rates of atmospheric deposition Track atmospheric concentrations of particulates and gases, levels of radiation--emphasizing those with known human health or environmental impacts Monitor core weather/climate conditions within each park (on each island) Monitor frequency and intensity (severity) of extreme events (hurricanes, waves, winds, rain, etc.) Identify and monitor spatial patterns of climate, such as trade-wind inversion elevation, lifting condensation level, lapse rates, etc.
Physical / Chemical Environment	Climate & Air Quality		Monitor physical ocean dynamics--ocean currents, sea level, tides/swell Monitor cycles of nutrients and elements within soils and water--including carbonate (oceanic), nitrogen, and phosphorous Monitor soil erosion Monitor soil quality trends (physical, toxics/contaminants, other biologic and nutrients) Monitor condition and extent of soil crusts Monitor trends in surface water flow regimes Monitor wetland (incl. anchialine ponds) water flow exchange dynamics, size, and distribution Monitor ground water flow rates and direction of movement (recharge)
	Soil, Water, & Nutrient Dynamics		Monitor water quality core parameters Monitor supplemental water quality parameters Monitor microbiological water quality parameters Monitor toxic and contaminant levels in water Monitor biological invertebrate communities
	Water Quality		Monitor surface volcanic activity (lava flows, eruption events & ground deformation) Monitor volcanic & non-volcanic seismicity Monitor extent, location, and causes of mass wasting events (e.g. landslides)
	Geology	Hazards	Monitor shoreline dynamics Track dune locations and topography Identify and monitor the extent of permafrost Monitor karst and non-karst cave and lava tube habitat characteristics, topography, and extent
		Landforms	
Biotic Integrity	Terrestrial Ecosystems	Vegetation	Monitor patterns of distribution & extent of community types Monitor fire regimes and effect on vegetation Track insect and disease presence during forest dieback
			Monitor community dynamics, structure, function, and composition Monitor effects of management on native communities
			Monitor effects of biocontrol on native and invasive species Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor disease incidence and impacts, especially on native species Monitor extent and response to treatment of established invasive species Monitor occurrence of non-established (incipient) invasive species
		Consumers	Monitor community dynamics, structure, function, and composition Monitor effects of management on native communities
			Monitor effects of biocontrol on native and invasive species Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor disease incidence and impacts, especially on native species Monitor extent and response to treatment of established invasive species Monitor occurrence of non-established (incipient) invasive species
			Cave Systems Community Monitor changes in cave communities
		Freshwater Ecosystems	Producers Monitor community composition, structure, and productivity
			Community Monitor community dynamics, structure, function, and composition
			Monitor disease incidence and impacts, especially on native species
			Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor extent and response to treatment of established invasive species Monitor occurrence of non-established (incipient) invasive species
	Marine Ecosystems	Benthic	Landscape Monitor patterns of distribution & extent of community types
			Community Monitor community dynamics, structure, function, and composition
			Population Track community and population trends in harvested fisheries / collected species Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor disease incidence and impacts, especially on native species Monitor extent and response to treatment of established invasive species Monitor occurrence of non-established (incipient) invasive species
			Community Monitor community dynamics, structure, function, and composition
		Water column (motile)	Track community and population trends in harvested fisheries species Monitor disease incidence and impacts, especially on native species Monitor extent and response to treatment of established invasive species
			Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor occurrence of non-established (incipient) invasive species
			Community Monitor community dynamics, structure, function, and composition
			Track community and population trends in harvested fisheries collected species Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
		Intertidal	Monitor extent and response to treatment of established invasive species Monitor occurrence of non-established (incipient) invasive species